MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

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Standard Reference Materials Program
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SRM Number: 3161a
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SRM Name: Tin Standard Solution

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Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of tin. One unit of SRM 3161a consists of 50 mL of a single element solution in a high density polyethylene bottle sealed in an aluminized bag. The solution is prepared gravimetrically to contain a known mass fraction of tin. The solution contains nitric and hydroflouric acid at a volume fraction of approximately 5 % and 1 %, respectively.

Material Name: Tin Standard Solution

Other Designations:

Tin: Stannum; elemental tin; tin metal.
Tin Nitrate: Stannic nitrate; tin (IV) nitrate.
Nitric Acid: Aqua fortis; hydronitrate; hydrogen nitrate; azotic acid; engraver's acid.
Hydrofluoric acid: Hydrogen fluoride; fluorhydric acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	5
Hydrofluoric Acid	7664-39-3	231-634-8	2
Tin (IV) Nitrate	41480-79-9	(Not found)	3.08
Tin	7440-31-5	231-141-8	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid and hydrofluoric acid can both cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. HF can also damage bones. Tin and tin compounds may irritate the skin, eyes, respiratory tract, and GI tract. "Metal fume fever" may also occur (flu-like symptoms after inhaling metal dust).

Physical Hazards: Container may break.

Potential Health Effects

Inhalation: Nitric acid or hydrofluoric acid, if inhaled, can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Inhalation of tin and inorganic tin compounds may cause respiratory irritation. Tin oxide fumes (from thermal decomposition) or tin dust may cause temporary flu-like symptoms called metal fume fever. Effects may include thirst, fever, chills, mental changes, and an unusual taste in the mouth.

Skin Contact: Nitric acid and hydrofluoric acid can both cause severe skin burns. Effects of acid burns may be delayed. Hydrofluoric acid may also penetrate skin and damage the underlying tissues and bones; severe or fatal hypocalcemia may result. Skin contact with tin dust or compounds may cause irritation.

Eye Contact: Nitric acid and hydrofluoric acid can both cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Eye contact with tin dust or compounds may cause irritation.

Ingestion: Nitric acid and hydrofluoric acid can both cause severe burns and damage to the GI tract. Tin compounds are relatively nontoxic because of poor absorption from the GI tract, but a large dose or chronic exposure may cause abdominal pain, nausea, vomiting, and diarrhea. Repeated or prolonged ingestion of inorganic nitrates can cause anemia, kidney disease, and blood abnormalities.

Medical Conditions Aggravated by Exposure: The mixture and its four components may aggravate pre-existing disorders of the eyes, skin, GI tract, and respiratory tract. Since hydrofluoric acid can severely reduce blood calcium levels, it can also aggravate osteoporosis, hypoparathyroidism, or other disorders of calcium metabolism.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified medical personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. Fire Fighting Measures

Fire and Explosion Hazards: Although nitric acid and tin (IV) nitrate do not burn, both are powerful oxidizing agents that can react with combustible materials to cause fires. Hydrofluoric acid may ignite or explode on contact with combustible materials. HF in contact with some metals can also produce explosive hydrogen gas. Finely divided tin dust (not present in this mixture) may explode.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. Accidental Release Measures

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. Handling and Storage

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials. Use opened containers immediately or discard.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. Exposure Controls and Personal Protection

Nitric Acid:

ACGIH TLV-TWA: 2ppm or 5 mg/m^3

OSHA TLV-TWA: 2 ppm or 5 mg/m^3

Hydrofluoric Acid:

ACGIH TLV-TWA: 3 ppm or 2.5 mg/m^3

OSHA TLV-TWA: 3 ppm or 2.5 mg/m^3

Tin Nitrate:

OSHA TLV-TWA: 2 mg/m^3 (for tin inorganic compounds except oxides)

DOE Temporary Emergency Exposure Limit (TEEL-0): 4 mg/m^3

Tin:

ACGIH TLV-TWA: 2 mg/m^3

OSHA TLV-TWA: 2 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Hydrofluoric Acid	Tin Nitrate	Tin
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** Colorless, fuming liquid; strong, irritating, pungent odor.	**Appearance and Odor:** Silky crystals	**Appearance and Odor:** Lustrous, white powder or solid; odorless
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 20.01	**Relative Molecular Weight:** 366.71	**Relative Molecular Weight:** 118.69
Molecular Formula: HNO_3	**Molecular Formula:** HF	**Molecular Formula:** $Sn(NO_3)_4$	**Molecular Formula:** Sn
Specific Gravity: 1.0543 (10%)	**Specific Gravity:** 0.99	**Specific Gravity:** N/A	**Specific Gravity:** 7.28
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in alcohol, benzene, toluene, *m*-xylene, and tetralin.	**Solvent Solubility:** N/A	**Solvent Solubility:** Soluble in hydrochloric acid, sulfuric acid, aqua regia, and alkali solutions
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Decomposes in cold water	**Water Solubility:** Insoluble
Boiling Point (°C): 86 (187°F)	**Boiling Point (°C):** 108 (226°F)	**Boiling Point (°C):** N/A	**Boiling Point (°C):** 2507 (4545°F)
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** 1.97	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
pH: 1.0 (0.1M solution)	**pH:** 1.0 (0.1M solution)	**pH:** N/A	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of tin, nitric acid, and hydrofluoric acid. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Heat, flames, ignition sources; contact with combustible materials or other incompatibles.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Hydrofluoric Acid: Incompatible with amines, bases, metal oxides, cyanides, combustible materials, halogens, metals, oxidizing materials, metal salts, and reducing agents.

Tin Nitrate: Limited data available. Do not store with alcohol, ammonium salts, combustible or flammable materials, metals, reducing agents, acids.

Tin: Incompatible with halogens, halogen trifluorides, cupric nitrate, sodium and potassium peroxide, sulfur, and some acids. Tin metal (not present in this mixture) oxidizes in the presence of moisture and heat, forming a layer of tin oxide.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of this mixture may release halogenated (fluorinated) compounds and toxic or hazardous gases, including nitrogen oxides (NO, NO_2, N_2O) and tin oxide.

Hazardous Polymerization: _____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg
Rat, oral: LD_{50} > 90 mg/kg
Rat, inhalation: LC_{50} (4 hrs) = 130 mg/m^3

Hydrofluoric Acid:

Human, oral: TD_{Lo} = 143 mg/kg
Human, inhalation: TC_{Lo} (5 min.) = 100 mg/m^3

Tin Nitrate: No acute toxicity data were found for this specific tin compound. See Tin.

Tin: By the oral route, tin is practically nontoxic to humans and laboratory animals. Only about 2% of ingested tin is absorbed from the human GI tract.

Target Organ(s): Respiratory tract, eyes, skin, GI tract, kidneys, liver, bones, teeth.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has also been investigated as a possible mutagen.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC_{50} (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC_{50} (48 hrs) = 330,000 to 1,000,000 µg/L

Hydrofluoric Acid: Acid soils can bind fluorides tightly. Plants may be damaged in soils with high calcium content, which can immobilize fluorides. Ecotoxicity data for HF:

Shrimp in aerated seawater: LC_{50} (48 hrs) = 300 ppm
Mosquito fish (*Gambusia affinis*): LC_{50} (96 hrs) = 925 mg/L
Freshwater fish (*Leuciscus idus*): LC_{50} (48 hrs) = 660 mg/L

Tin Nitrate: No ecotoxicity data are available for this specific tin compound. The following data are for Sn^{4+} from tin (IV) chloride and sodium stannate (Na_2SnO_3):

Water flea (*Daphnia magna*): LC_{50} (48 hrs) = 32.9 mg/L
Killifish (*Oryzias latipes*): LC_{50} (48 hrs) = 480 mg/L
Zebra fish (*Brachydanio rerio*): LC_{50} (96 hrs) >1000 mg/L

Tin: Since elemental tin is not soluble in water, most of it ends up in soil and sediment, where it is gradually converted to tin oxide. Tin oxide is stable and inert under normal environmental conditions; no ecotoxicity data are available. Tin may bioaccumulate in some aquatic organisms, but data are limited.

Environmental Summary: Some components of this mixture are at least slightly toxic to aquatic organisms. Spills should not be released to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture is a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution: Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lbs.
Hydrofluoric Acid: RQ = 100 lbs.
Tin Nitrate: Not regulated.
Tin: Not regulated

SARA Title III Section 302: Nitric acid and hydrofluoric acid are regulated.

SARA Title III Section 304: Nitric acid and hydrofluoric acid are regulated.

SARA Title III Section 313: Nitric acid and hydrofluoric acid are regulated. Tin nitrate is regulated as N511, Nitrate Compounds.

OSHA Process Safety (29 CFR 1910.119): Hydrofluoric acid is regulated. Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: None of the components are regulated.

CANADIAN REGULATIONS

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Hydrofluoric Acid: D1A (very toxic material), E (corrosive material)
Tin Nitrate: C (oxidizing material)
Tin: D2B (toxic material)

WHMIS Ingredient Disclosure List: All four components are regulated. (Tin nitrate is regulated as Tin Compounds, n.o.s.)

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Hydrofluoric Acid: T+ (Very Toxic), C (Corrosive)
Tin (IV) Nitrate: O (Oxidizer); not found in EC database.
Tin: XN (Harmful); not classified in Annex I of Directive 67/548/EEC; not on a priority list.

Risk Phrases (mixture):

R26/27/28 (very toxic by inhalation, in contact with skin, and if swallowed)
R35 (causes severe burns)
R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S26 (in case of eye contact, rinse immediately and seek medical advice)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): Nitric acid, hydrofluoric acid, and tin are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

Hazardous Substances Data Bank (HSDB): Tin and Tin Compounds.

Howe P, Watts P, Tin and Inorganic Tin Compounds. Concise International Chemical Assessment Document 65. Geneva: World Health Organization, 2005.

IUCLID Chemical Data Sheet: Hydrogen Fluoride. European Chemicals Bureau, 19 February 2000.

IUCLID Chemical Data Sheet: Nitric Acid. European Chemicals Bureau, 19 February 2000.

IUCLID Chemical Data Sheet: Tin. European Chemicals Bureau, 19 February 2000.

U.S. Department of Energy. ERPGs and TEELs for Chemicals of Concern. DKC-04-0003, Rev 20, April 2004.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, June 1990 edition. DHHS (NIOSH) Publication No. 90-117.